Northeast Climate Science Center

Preliminary Science Focus Areas

Addendum to

Statement of Interest and Proposal Solicitation and Guidelines

March 12, 2012

Science Priorities. Science priorities were identified in consultation with the coordinators and science coordinators for the North Atlantic, Appalachian, Eastern Tallgrass Prairie & Big Rivers and Upper Midwest Great Lakes LCCs. These needs are considered by the LCCs to be foundations for LCC science activities and for future work by the NECSC. Two addition science priorities are included that have been identified by other DOI agencies and partnerships as high priorities for their climate science needs. Together, these six priorities will provide foundational information to help enhance consistency in research across the NECSC. In addition, we will coordinate with LCCS and other Climate Science Centers to fully utilize their existing efforts to conduct outreach so as to avoid over-extending our resources for outreach and to avoid repetition with LCCs and other organizations.

1) Critically Evaluating Existing Methods and Supporting a Standardization of Terrestrial and Wetland Habitat Classification and Mapping that Includes Characterization of Climate Sensitive Systems.

2)Assembling Key Climate Data and Critically Evaluating Approaches for Stream Temperature and Ecological Flows to Help Identify Climate Trends and Input Data for Coupled Modeling Efforts and Monitoring.

3) Developing and Applying Models, Maps and Monitoring to Guide Adaptation Decisions Related to Sea Level Rise and Increased Storm Intensity

4) Great Lakes Fisheries Trophic Structure Response to Climate Change

5) ***Identifying Potential Impacts of Climate Change on Urban Rivers, Parks and Refugees and Adaptive Strategies for Response to Climate Change in Urban Natural Resources.***

6) Effects and Interaction of Climate Change with Zoonotic, Wildlife and Plant Disease in the Northeastern and Midwestern United States.

Detailed Statements of Interest are listed below.

1. ***Critically Evaluating Existing Methods and Supporting a Standardization of Terrestrial and Wetland Habitat Classification and Mapping that Includes Characterization of Climate Sensitive Systems.***

   Ecosystem and Land Use Types Addressed: This project is relevant to all major regional terrestrial sectors, including forests, agro-ecosystems, grasslands and prairies, and urban areas. If combined with other extant hydrological datasets, it can incorporate freshwater ecosystems as well.

Project Goal: Facilitate development of a standardized, consistent, and accurate landscape-scale dataset of terrestrial and wetland habitat and ecosystems based on a common mid-level classification framework for the entire Northeast-Midwest region (including adjacent areas of Canada); and Identify knowledge gaps and research to fill these gaps for vulnerable terrestrial and wetland habitats, (for example, such as Eastern montane forested habitats). The resulting foundational products will have many applications, such as assessing species and ecosystem vulnerability to climate change, evaluating and modeling species-habitat relationships, understanding regional biodiversity patterns; and facilitating more coordinated, effective, and efficient habitat conservation across the region.

Recommended Steps. Phase I: systematically review and compare the ecosystem classification frameworks and land cover/habitat mapping products within the region (including areas of the Upper Midwest and Great Lakes, Eastern Tallgrass Prairie, North Atlantic, and Appalachian Landscape Conservation Cooperatives). For GIS datasets, this should include comparing their resolution, accuracy, the underlying data necessary for their development (e.g., satellite imagery, terrain data), and how they were developed. For areas not encompassed by the other regional habitat mapping projects (e.g., Southeast GAP, Northeast Terrestrial Habitats), this phase should consider habitat classification systems used by state natural heritage programs, State Wildlife Action Plans, the National Park Service, Canadian provinces, and other sub-regional entities if available. This phase and all subsequent phases should be conducted in consultation with Landscape Conservation Cooperative (LCC) partners and in coordination with a similar project recently initiated for the Appalachian LCC.

Phase II: based on the results of Phase I, develop a habitat/land cover classification system for areas not encompassed by contemporary regional mapping efforts, if existing classification systems are incomplete or inconsistent for this region. It is expected that NatureServe ecological systems, Omernik's Level III Ecoregions of the Continental United States, and the LANDFIRE National Map Legend will serve as important reference points for the system, and the system should be compatible with the existing regional classifications. Additionally, ecological units within the classification system that are anticipated to be particularly sensitive to climate change should be identified; examples might include high elevation systems with narrow climate tolerances.

Phase III: a) develop recommendations and a plan for how to extend existing products, or develop new products, for areas not encompassed by current regional habitat mapping efforts, and b) as necessary, develop recommendations and a plan for how to reconcile classification and

mapping inconsistencies between existing products (that, for example, may result in mapping artifacts at "seams" between adjacent regional products).

Phase IV: implement recommendations and plans of Phase III, resulting in GIS datasets of the mapped ecological units, complete with accompanying metadata; base layers used to develop the products; and a report summarizing the methodology used. Products must comply with Federal standards and requirements for geospatial content and metadata. If it is not possible in this project to develop maps for all areas where needed, partial mapping may be conducted based on criteria such as feasibility (e.g., availability of base data, availability and interest of local partners to contribute to the project), proximity to currently mapped areas, and projected sensitivity to climate change.

Current Science Resources: NatureServe and partners have developed a mid-level classification system termed "Ecological Systems" that is being used as a basis for land cover mapping in many regions. At least three efforts completed or underway that can serve as models for regional mapping:

- The Terrestrial Habitats of the Northeast and Mid-Atlantic dataset developed by The Nature Conservancy in 2011 that applies the Northeast Terrestrial Habitat Classification System to the 13 northeastern states.
- Southeast GAP Land Cover Dataset, which also classifies land cover using Ecological Systems.
- The Northeastern and Upper Midwestern Terrestrial Habitat Classification System currently under development by NatureServe, which includes mapping for Midwestern states.

Despite these efforts, gaps exist in the Northeast-Midwest region, including the Canadian portions of the North Atlantic and the Upper Midwest and Great Lakes LCCs. National-level products, including the National Land Cover Dataset and LANDFIRE, while extremely valuable, are commonly considered insufficiently detailed or precise for certain important applications of landscape-scale conservation assessment and design.

Relevance to Regional LCCs: A consistent, accurate landscape dataset is a foundational product that is of high value to LCCs in the region. This topic has been identified as being of one of the highest priorities to the Appalachian LCC as an outcome of their recent science needs workshop. The Upper Midwest and Great Lakes LCC also considers this to be an important topic. Expanding this mapping into Canada is a priority for the North Atlantic LCC. Because the Northeast land cover dataset developed by The Nature Conservancy is a fundamental building block for the North Atlantic LCC, a comparable and consistent dataset available for the entire region would be of high value to this LCC so that other projects can be coordinated with and expanded into neighboring LCCs and into Canada.

Potential Collaborators and Partners: The Appalachian LCC has identified a similar activity as a science priority on terrestrial landscapes in a Request for Applications (see http://applcc.org/page/project-support). The Southeast Climate Science Center has identified "unique climate-vulnerable and climate-sensitive ecosystems their key stressors and adaptation/mitigation options in a Statement of Interest and Proposal Solicitation and Guidelines (see: http://www.doi.gov/csc/southeast/news/Southeast-Climate-Science-Center-News.cfm.)

2. ***Eco-hydrology: Assembling Key Climate Data to Identify Trends and as Input Data for Coupled Forecast Modeling Efforts to Assess the Vulnerability of Freshwater Riverine Habitats.***

Ecosystem and Land Use Types Addressed: Freshwater Ecosystems; Coastal and Ocean Ecosystems.

Project Goal: In order to be able to simulate long-term climate it is necessary to model the evolution of both the atmospheric and hydrological variables in their fundamentally two-way interactive setting. The NECSC seeks to unify climate and hydrology observational networks throughout the region to support integration of the watershed data collection network and facilitate coupled atmosphere-land surface-hydrology modeling capability needed to examine and understand these processes and develop and apply models for predicting the effect of climate change on stream temperature and hydrology and associated biological communities. To better respond to anticipated flow alteration and physical habitat degradation, managers need projections of how climate change will affect instream habitat quality and quantity. Global climate change models predict future precipitation and air temperature patterns on national and larger regional levels, but little is known about how actual stream temperature, discharge rates and water supply will be altered with climate change. Historic stream temperature and discharge data trends inform predictive temperature and flow models, and when combined with state-of-the-art down-scaled Global Circulation Models, can allow resource managers to make decisions now that will most effectively and efficiently conserve species, habitats and economic uses of water resources in the future.

Recommended Steps: Objectives & Deliverables to be implemented over up to 2-year period, with minimum of Track A or Track B, Phase I tasks (if Track A is preexisting) delivered at 12-month mark**):**

Track A - Foundational Temperature Data
Determine what long-term data sets exist for monitoring stream temperature within the NECSC area, and link these into one dataset usable by the NECSC and its partners to document geo-referenced historic fluctuations in steam temperature and inform ecological flow and climate change models to predict future instream conditions across the landscape. (Note: Compilations may already exist for some portions of New England; once determined, researchers would skip to Track B, Phase I for these geographic areas.)

Deliverables:

- Compiled list/database of significant temperature datasets, particularly paired air and water temperature data, for the NECSC region including sampling locations, date ranges, etc.

- Record of which data collection efforts are historic or on-going and by whom, and identification of gaps in data collection.
- Narrative and graphic depiction of historic trends in instream temperature as a means for evaluating future conditions.

Track B, Phase I - Model Assessments
Synthesize the state of the science regarding the use of the various existing rainfall-runoff and statistical hydrologic/hydraulic models, stream temperature models, and methods for linking hydrologic and temperature models, to support investigations of the effects of climate and land cover change on stream ecology and hydrology. The synthesis should consider the advantages and disadvantages of each modeling approach at multiple scales and the potential for integration with models for other aquatic and terrestrial systems. The synthesis should also provide information about the capabilities of each model to portray uncertainty in model parameters and model predictions. (**Note:** Phase I will require coordination with a regional model comparison project currently being conducted by the Office of Surface Water at USGS, model assessment work products funded by the South Atlantic, North Atlantic, and Appalachian LCC.)

Deliverables:
- A narrative report summarizing the most widely used hydrologic and temperature models, and the origin of each.
- A qualitative and quantitative assessment of the strengths and weaknesses of each model, summarized in tabular form, and including its ability to portray uncertainty in parameters or predictions.

Track B, Phase II.
Based on Track A (or preexisting) Temperature Data Compilations, hydrology data from the USGS National Streamflow Information Program (or other preexisting), and Track B, Phase I Model Assessments, develop or adopt, and then apply, predictive model(s) that can be coupled to simulate how climate change atmospheric scenarios will alter critical physical instream habitat parameters including stream temperature, flow and geomorphology. Coupled model testing and demonstrations for Track B, Phase II can be proposed once Phase I is completed, and these may utilize smaller geographic areas as paired watersheds that represent the larger NECSC area.

Deliverables:
- Provide regional forecasts for discharge (including peak high and low flows) and stream temperature utilizing state-of-the-art Global Climate Models (GCM) predictions for precipitation and air temperature trends.
- Pair down-scaled GCM with data and outcomes from Track A (or equivalent) and Phase I to "ground" GCM and improve the accuracy of predictions for the NECSC region; provide these predictions in the form of a narrative summary report with appropriate graphic illustrations.

Relevance to Regional LCCs: Development and sharing of these temperature and hydrological data sets among LCCs will provide a uniform basis for more applied and geographically specific research studies that will aid resource managers to make decisions to most effectively and efficiently conserve species, habitats and economic uses of water resources in the future.

Potential Collaborators and Partners: The Appalachian LCC has released a Request for Applications regarding ecological flows, (see http://applcc.org/page/project-support) and the Southeast Climate Science Center has released a Statement of Interest and Proposal Solicitation and Guidelines (see: http://www.doi.gov/csc/southeast/news/Southeast-Climate-Science-Center-News.cfm.)

3. Developing and Applying Models, Maps and Monitoring to Guide Adaptation Decisions For Coastal Natural Resources (such as Federal and other public coastal resources) Related to Sea Level Rise and Increased Storm Intensity

Ecosystem and Land Use Types Addressed: Coastal and Marine Ecosystems.

Project Goal: Evaluate options and apply a regional sea level rise model to assess habitat impacts along the North Atlantic coast as part of the existing landscape change model.
Overview. Atlantic coastal areas are highly complex systems, vulnerable to abrupt change, and stressed by human development activities. Future sea level rise, coupled with changes in storm intensity and freshwater runoff, will likely result in dramatic changes in coastal systems, affecting natural and built habitats. A high priority set of needs for the Atlantic Coast is to develop and test models and tools to increase understanding of climate change related impacts to coastal systems and habitats; to increase understanding of how these impacts will combine with other impacts; and to use this information to inform management decisions at regional and local scales. Specific needs include synthesizing and assessing the state of knowledge of: approaches for projecting sea level rise and storm intensity at regional scales; tools and other methods to assist coastal communities and natural resource managers in anticipating and understanding the effects of sea level rise and storms on natural and human communities; and foundational spatial data needed for projecting these impacts. An important outcome of this work will be a base of knowledge and assessment of available tools that managers and scientists in the area served by the Northeast CSC (and Southeast CSC) can use to plan future management and scientific activities. Based on this assessment, there is a need to apply and test sea level rise and storm models at regional and local scales and incorporate them into existing landscape change models that are useful for conservation decisions at multiple spatial and temporal scales. Also based on this assessment there may be a set of foundational data and monitoring needs including coastal habitat mapping, high resolution elevation data, and coastal habitat monitoring to detect changes.

Recommended Steps: 1) Evaluate options for models and approaches to meet regional scale and local scale needs at decision-relevant time scales and recommend approaches for further development and application. At the regional scale that means agreeing on a tool or set of tools that project the loss, increase or conversion of coastal wetlands and beaches and other habitats as a result of sea level rise under a range of scenarios at a resolution that allows for assessments of the impact of those changes on the capability of those habitats to support fish, wildlife and plant species. This evaluation should be guided by a structured decision-making process that includes scientists, modelers and local and regional decision makers.

2) Based on the results of task 1, apply a regional sea level rise model along the coast of the Northeast CSC area using a broad range of climate change scenarios. This model should be able to project the loss or change of coastal habitats as a result of sea level rise at a resolution that

allows for assessments of the impact of those changes on the capability of those habitats to support fish and wildlife species. The model needs to be integrated into the Landscape Change, Assessment and Design model that the North Atlantic LCC is developing as part of the Designing Sustainable Landscapes project through the University of Massachusetts.

Current Science Resources: There have been a variety of sea level rise and storm intensity models and tools developed at regional and local scales along the U.S. Atlantic Coast and elsewhere but little consensus on their effectiveness or utility for making management decisions at various spatial and temporal scales. Various syntheses of existing modeling efforts and coastal adaptation have been completed or are underway in the North Atlantic through the Northeast Regional Habitat Vulnerability Assessment, NOAA, regional ocean partnerships (Northeast Regional Oceans Council and Mid Atlantic Regional Council on the Oceans) and others. The Southeast Climate Science Center is proposing a synthesis of approaches and tools in the Southeast.

Relevance to Regional LCCs: This need is only relevant to one LCC in the Northeast CSC area because there is only one LCC in that area that has marine coastline. It is applicable to multiple coastal LCCs including the two other LCCs along the Atlantic Coast, the South Atlantic and Peninsular Florida LCCs.

Relevance to Regional Sectors/Habitats
This need is relevant to the coastal and marine sector and is the highest priority for that sector identified by the North Atlantic LCC.

Potential Collaborators and Partners: The Southeast Climate Science Center is proposing a synthesis of approaches and tools in the Southeast (a Statement of Interest and Proposal Solicitation and Guidelines (see: http://www.doi.gov/csc/southeast/news/Southeast-Climate-Science-Center-News.cfm.) Collaboration between the Northeast and Southeast Climate Science Centers to address this need would ensure greater consistency. There are opportunities for collaboration among the Northeast and Southeast CSCs, the North Atlantic, South Atlantic and Peninsular Florida LCCs and associated partners including the University of Massachusetts Amherst, North Carolina State University, Columbia University, USGS, NOAA, and the regional ocean partnerships. In order to understand changes to coastal habitats along the Atlantic Coast there is a need for regionally consistent, high resolution coastal wetland maps that complement the existing northeast terrestrial habitat maps, National Wetland Inventory maps and planned Coastal and Marine Ecological Classification System (CMECS). Additionally, to understand changes to salt marshes and other coastal wetlands along the Atlantic Coast there is a need for a comprehensive network of salt marsh monitoring including salt marsh elevations and integrity. This network should build on existing monitoring networks including the National Park Service and National Wildlife Refuge I&M networks.

4. ***Great Lakes Fisheries Trophic Structure Response to Climate Change*: *field investigation of fish trophic interactions and other species interactions with conceptual and quantitative modeling to predict the impact of forecasted climate change on Great Lake fisheries*.**

Ecosystem and Land Use Types Addressed: Coastal and Ocean Ecosystems (defined as including the Great Lakes).

Project Goal. To develop information that can predict fish population response to climate change and other land use/water use interactions.

Overview. The Great Lakes harbor a complex ecosystem with a mixture of cold, cool and warm water fish guilds that support a variety of productive multijurisdictional fisheries. Consequently, increases in temperature, freshwater inputs, and eutrophication are predicted to result in a northward expansion of cool and warm water fish populations and a reduction in habitat for cold water species. Great Lakes fishery managers strive to maintain food web structures that provide optimum production of exploited fish species. Rapidly changing climate will alter those food web dynamics and consequently the sustainability of fish resources. There is a great need to understand how climate driven changes might influence food webs before such changes are realized. Managers need synoptic indicators of food web structure that support an adaptive response to such variability.

Recommended Steps: Research should build upon existing research and focus on:
1) How do predator-prey interactions between cool and coldwater fish guilds change as environmental conditions direct them into closer contact?
2) Does prey selection become more intense, leading to segregation of diets across species within a trophic level or does diet overlap increase between potentially competing species as a result of environmental change?
3) How does the length and structure of the food web and trophic level of secondary consumers change with environmentally driven changes in vertical and horizontal distribution?

Expected Outcomes:

1. Quantification of vertical and horizontal distribution changes of dominant prey and predator fishes during spring, summer stratification and fall turnover;
2. Characterization of spatial and temporal variability in diet and trophic position of fishes in response to seasonal environmental changes;
3. Development of synoptic trophic interaction indicator variables that capture seasonal environmental variability as related to long-term climate change.

Relevance to Regional LCCs: Results of this research will assist in forecasting future changes in fish populations expected with climate change and assist international, Federal and state agencies and organizations be manage fisheries resources and stabilize populations.

Potential Collaborators and Partners: The U.S. Geological Survey Great Lakes Science Center, (http://www.glsc.usgs.gov/), conducts research monitors fish populations in the Great Lakes and works collaborative with The Great Lakes Restoration Initiative (see **http://www.epa.gov/glnpo/glri/**).

5. Evaluating and Identifying Potential Impacts of Climate Change on Urban Rivers, Parks and Refugees and Adaptive Strategies for Response to Climate Change in Urban Watersheds and Landscapes.

Ecosystem and Land Use Types Addressed: Freshwater Ecosystems, Coastal and Ocean Ecosystems; Urban Ecosystems.

Project Goal: Evaluate environmental services and socio-economic values associated with urban river corridors; determine the potential impact of climate change on urban river hydrology, water quality, habitat values and recreational values, particularly in urban parks, refugees and other natural areas within urban landscapes.

Overview. Through multi-sector partnerships such as the Urban Water Federal Partnership and the Great Outdoors Initiative, Federal, State and Local agencies and organizations have been focusing on restoration and protection of urban river habitats. Urban waters often serve as sources for drinking water, provide habitat for wildlife and fisheries and provide environmental, economic and social services to urban communities. The goal of a project or projects to address this science priority is to

1) Develop science-based approaches to evaluate the environmental and socio-economic services of urban river corridors in the Northeast and Midwest, including evaluation of water resource values, fish and wildlife habitat, recreational use and direct economic contributions to urban economies;
2) Develop models and/or forecasting tools that will predict the effects of climate change on urban river corridors, park and other natural areas in urban settings, including impacts on hydrology, (e.g., flow and flow variability), fish habitat and fish passage; wildlife habitat; water quality and human and wildlife health.
3) Develop tools to guide natural resource management in urban river corridors in light of expected changes due to climate change and how these changes might affect water resources, fish and wildlife, recreational and cultural resources and urban communities and infrastructure.

Recommended Steps. The Urban Waters Federal Partnership (UWFP), including DOI, EPA, DOT, HHS, HUD, and USDA, brings these partners together to assist urban communities in revitalizing and improving the Nation's waterways and promote their economic, environmental and social benefits. The partnership builds on local organizations and efforts and can provide contacts with local leadership to gage technical and science-based needs. The UPWP has selected 7 pilot urban waterways. Four of these seven are within the geographic region of the NECSC. In the Northeast and Midwest they include:

- Anacostia River (Washington, DC/Maryland)
- Bronx & Harlem River Watersheds (New York)
- Patapsco River (Baltimore)
- Gary, Indiana

Working with the UWFP and its DOI partners, (including the National Park Service, U. S. Geological Survey and the U.S. Fish and Wildlife Service), with provide connections with local needs and with regional and local Offices, Parks and Refuges. However, other urban corridors, particularly those that are in need of technical assistance and resources, would provide reproducible results that could be shared among the UPWP pilots and UPWP partners.

Relevance to Regional LCCs: The NECSC has the highest density of urban centers among the eight DOI Climate Science Centers. Projects will assist all LCCs and their partners to expand and connect natural resource management research with socio-economic research in urban ecosystems.

Potential Collaborators and Partners: For contact with DOI partners with the UWFP, contact:
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6. Effects and Interaction of Climate Change with Zoonotic, Wildlife and Plant Diseases and with Environmental Contaminants in the Northeastern and Midwestern United States.

Ecosystem and Land Use Types Addressed: Urban Ecosystems; Freshwater Ecosystems; Marine and Coastal Ecosystems.

Project Goal: Conduct research that will indicate how climate change will alter the distribution of zoonotic, wildlife and plant diseases and the interaction of disease with environmental contaminants in the Northeast and Midwest United States.

Overview. Climate change has the potential to play a significant role in affecting the health of aquatic and terrestrial wildlife, humans and domestic animals. Some of these impacts may be due to changes in the burden and distribution of disease. The effects can be both direct and indirect. Among the direct effects are changes in environmental factors such as temperature, precipitation, and severity of storms that can increase exposure to natural or anthropogenic sources of contaminants and toxins, or that can result in alterations to the host-pathogen relationship. It is imperative to understand how climate change will alter the risk of exposure to toxins, contaminants and pathogens and the potential impact of that exposure on fish, wildlife, plants and human populations. This knowledge will be critical for identifying and predicting health risks and developing adaptive management strategies. Examples of direct effects are severe rainfall events leading to increased mobilization of acid mine waste, changes in wind patterns resulting in greater exposure to dust-borne contaminants and pathogens; and temperature-induced changes in the host-pathogen relationship in plants and cold-blooded animals.

Climate change can have indirect effects on human and animal health through a reduction in biodiversity, degradation of ecosystem processes, alteration of habitat, as well as changes in the distribution patterns of species, pathogens and disease vectors. Climate change may alter the

geographic range and distribution of infectious diseases and disease vectors; patterns and cycles of disease, virulence of pathogens. Climate change will also likely alter community and ecosystem composition and member interactions which can have health effects.

Recommended Steps: To enhance understanding of the relationship between environmental health and climate change we solicit projects that follow the following areas of study:

- Initiate projects focused on disease ecology in representative ecosystems that overlap the NECSC region and that are subject to current or foreseeable climate change;
- Evaluate disease and contaminant impacts on threatened and endangered free-ranging wildlife populations with the goal of acquiring the knowledge needed to guide the development of adaptive management strategies for vulnerable populations;
- Evaluate the role of climate change in altering the ecology of wildlife (terrestrial and aquatic) associated foodborne disease;
- Evaluate the role of climate change on the mobilization or distribution of contaminants and toxins that affect humans, wildlife or plants, (terrestrial and aquatic) in both rural and urban environments.

Relevance to Regional LCCs: Research will assist LCCs in the NECSC region to anticipate and provide science-based information on the effects of climate change on human health as well as impacts and interaction of disease and contaminants on fish, wildlife, plants and the ecosystems on which they depend.

Potential Collaborators and Partners: The U.S. Geological Survey Wildlife Health Center, the Leetown Science Center, the Patuxent Environmental Science Center, the Columbia Environmental Science Center and Upper Midwest Environmental Sciences Center as well as U.S. Geological Survey Water Science Centers have active research on the effects of disease and contaminants on fish, wildlife, plants and ecosystems. Potential investigators are recommended to visit the agency website at: http://www.usgs.gov/.